

CHAPTER 3 SURFACE WATER MONITORING PROGRAMS

At the core of assessing the quality of the Commonwealth's waters are the data generated from the collection and analysis of ambient surface water samples. DEQ has a long history of water quality monitoring, beginning with the first sample collected in June 1941. Over the years, the focus of monitoring has been guided by various regulatory and assessment needs. With the development and implementation of the Water Quality Monitoring Strategy in 2000, the ambient monitoring program entered a new era of statewide multilayered network monitoring that is designed to produce representative data that supports the evaluation, restoration, and protection of the quality of the Commonwealth's waters for the purposes of fishing, swimming, boating, drinking, and the propagation and growth of a balanced, healthy community of indigenous aquatic organisms. The strategy was updated in 2004 and 2007 and has been formally approved by the United States Environmental Protection Agency (USEPA).¹

To achieve this goal and satisfy scientific, legislative and aesthetic requirements related to the quality of the Commonwealth's aquatic resources, DEQ has established a series of specific objectives to identify and define the diverse functions of the Water Quality Monitoring Program:

1. Assessment and Remediation Objectives:

(a) Status Quo Characterizations and Assessments:

- (1) Provide accurate, representative data for water quality characterization and assessment of all surface waters within the state.
- (2) Establish consistent statewide siting, parameter selection and monitoring techniques, to ensure data reliability and the comparability of data.
- (3) Assure that the frequency of sampling and the total number of observations collected are sufficient to provide adequate data for scientific, statistically based and defensible assessment procedures.
- (4) Assure that, whenever possible, flow rates are determined simultaneously with the collection of water quality data.
- (5) Monitor, according to a plan and schedule, all substances discharged into state waters that are subject to water quality standards or are otherwise necessary to determine water quality conditions.
- (6) Continually evaluate the overall success of the Commonwealth's water quality management efforts.

(b) Impaired Waters / Remediation:

- (7) Provide data to define the cause, severity and geographic extension of impaired waters:
- (8) Provide adequate data for TMDL model development and validation.
- (9) Provide adequate data, by means of follow-up monitoring, to evaluate the implementation of TMDL's and other best management practices.

(c) Variability, Trend Assessments and Forecasts:

- (10) Provide adequate data and analytical procedures for short, medium, and long-term statistical evaluation of water quality variation and trends within identifiable, geographically defined waterbodies.

2. Permit Objectives:

¹ Millennium 2000 Water Quality Monitoring Strategy, Virginia Department of Environmental Quality, October 2004.

(11) Provide data for the calculation of permit limits for the issuance, re-issuance and/or modification of effluent discharge permits.

(12) When water quality problems are suspected, provide data to detect and document water quality impairments and/or to evaluate permit adequacy, whether permitted dischargers are in compliance with permit limits or not.

3. Efficiency Objectives:

(13) Improve the efficiency of the Monitoring Program by minimizing resource requirements and the duplication of efforts while maximizing the use of integrated data collected by state and federal agencies, public utilities, private enterprises and citizens groups for statewide water quality assessments.

(14) Increase the use of biological monitoring (e.g., benthic macroinvertebrates, fish, and/or aquatic vegetation assemblages), as well as fish tissue and sediment monitoring for specific assessments of water quality.

(15) Investigate, identify and characterize additional avenues of actual or potential water quality impairment, including ground water contribution and aerial deposition.

(16) Guarantee adequate Quality Assurance/Quality Control (QA/QC) procedures to provide precise, accurate and representative water quality data for all assessment purposes.

4. Research Objectives:

(17) Provide data to validate special stream designations and/or specific water quality criteria.

(18) Evaluate new methodologies for sampling, analyzing and assessing water quality.

(19) Provide data for other research objectives.

As a result of the implementation of the new strategy, a monitoring network of multiple programs and special studies was identified and developed to include the following programs:

WATERSHED (AW) DEQ's ambient watershed network of stations represents the largest single section of the monitoring program. Detailed information on the purpose and objectives of these stations and their selection can be found in Section III.B. of the Monitoring Strategy.

ESTUARINE PROBABILISTIC MONITORING (C2) The estuarine probabilistic monitoring program covers the tidal estuarine waters of the Chesapeake Bay, coastal Delmarva and the Back Bay / North Landing River drainages. It is designed to characterize the Commonwealth's estuarine waters. This program is also integrated into National Coastal Assessment Surveys on a rotating basis once every five years.

CHESAPEAKE BAY (CB) Chesapeake Bay Program identified in section III.E.1 of the strategy. The design of this program is through the Federal-Interstate Chesapeake Bay Program and encompasses a multi-state water quality characterization effort, <http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay.aspx>.

CITIZEN MONITORING (CM) These stations are monitored due to specific requests from the public, usually as a result of local concerns. Notification occurs in the fourth quarter of the calendar year with sampling scheduled to begin in the next monitoring year, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx>.

FACILITY INSPECTION (FI) Facility inspections are not specifically identified in the water quality monitoring strategy but are integral to determining compliance with discharge limits. Specific sample locations are not included in the monitoring plan but only estimated numbers of samples for the purpose of calculating annual budgets.

FRESHWATER PROBABILISTIC (FP) The freshwater probabilistic monitoring program covers the non-Draft 2016

tidal free-flowing waters of the state. The program is designed to answer the question of what is the overall water quality of the Commonwealth for free-flowing streams: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx>.

FISH TISSUE (FT) Fish tissue and sediment monitoring program² conducted by central office staff, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx>.

MERCURY (HG) Mercury Special Study Program paid for by the responsible parties.

INCIDENT RESPONSE (IR) Incident response samples are the same as PC but are non-petroleum in origin.

POLLUTION COMPLAINTS (PC) Pollution complaints are special samples collected generally as a result of a petroleum spill.

REGIONAL BIOLOGICAL (RB) Biological monitoring program which focuses on the analysis of the benthic macroinvertebrate community as a tool to detect water quality conditions. The methodology follows the USEPA Rapid Bioassessment Protocol II. For additional information visit the biological program website at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/BiologicalMonitoring.aspx>.

RESERVOIR MONITORING (RL) Reservoir monitoring which is described in the Lake Monitoring Guidance³ available at <http://www.deq.virginia.gov/Portals/0/DEQ/Water/Guidance/092005.pdf>.

SPECIAL STUDIES (SS) Special studies are identified by individual project plans and are generally specialized intensive targeted monitoring efforts designed to answer specific hypothesis related to water quality conditions.

TMDL (TM) TMDL monitoring stations are those stations associated with the development of a TMDL and subsequent implementation plan for segments listed on the 303(d) list, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx>.

TREND (TR) Trend stations are those long term stations sited for permanent monitoring for the purpose of detecting water quality trends for a wide variety of environmentally important water quality parameters.

OBSERVED EFFECTS (OE) Those stations with insufficient data for assessing and usually are those stations with small data sets during an assessment cycle that indicate a potential problem. These stations are considered carryover stations and will be sampled until sufficient data is available to determine the water quality conditions.

Data Summary

Between January 2009 and December 2014 DEQ staff collected multiple samples at 4,205 stations. From these stations, the number of independent observations for the common field measurements was 120,309 for temperature, 96,240 for pH, and 118,910 for dissolved oxygen. These samples were analyzed for a variety of chemical constituents including nutrients, bacteria, metals, pesticides, herbicides and toxic organic compounds; over 600 different parameters were sampled.

² Virginia Department Of Environmental Quality, Water Quality Standards, Office Of Water Quality Programs 2001 Fish Tissue And Sediment Monitoring Plan, May 9th, 2001.

³ Lake Monitoring Guidance, Virginia Department of Environmental Quality, December 1999. Revised in 2002

The number of stations representing a particular type of stream segment, the types of samples collected, the parameters analyzed, and the sampling frequency all vary depending on site conditions and program emphasis. A detailed report of sample locations, matrices, parameters, and frequency is available in the Annual Monitoring Plans at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx>.

Each basin summary, found in Chapter 4.3 of this report, lists the ambient water quality monitoring (AWQM) and biological (benthic) monitoring summary data within the basin. Summaries of the sampling data collected at each station during the reporting period are provided as an Appendix supplement to this report and can be found on the DEQ water webpage <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs.aspx>.

Contact: For further information on the Ambient Monitoring Program contact:

Roger E. Stewart
629 East Main Street
Richmond, Virginia 23219
(804) 698-4449
roger.stewart@deq.virginia.gov

This chapter describes the water monitoring programs that provide data used in the 303(d)/305(b) assessment process.

CHAPTER 3.1 FRESHWATER BIOLOGICAL MONITORING PROGRAM

Virginia's freshwater biological monitoring program began in the 1970s to fulfill requirements of the Federal 106 Grant agreement. DEQ uses benthic macroinvertebrate communities to assess the ecological health of wadeable freshwater streams and rivers. Benthic macroinvertebrates are animals without backbones that live in or on sediment or other substrates and can be seen by the unaided eye. Benthics include crustaceans, mollusks, and immature forms of aquatic insects such as caddisfly, stonefly or mayfly nymphs.

Biological monitoring, using benthic macroinvertebrates, is an invaluable tool for evaluating the temporally integrated, overall effects of the water and sediment quality in streams and rivers. Benthic macroinvertebrate communities integrate water quality and the effects of different pollution stressors through time, providing a holistic measure of their aggregate impact. Because of their sedentary nature, macroinvertebrates are good indicators of localized conditions. Most species have a complex life cycle of approximately one year or more, and thus integrate the effects of fluctuations in water quality over time which conventional water quality surveys may miss. In essence, benthic macroinvertebrates are considered to be virtual "living recorders" of water quality conditions over time. The structure and functioning of macroinvertebrate communities are extremely sensitive. These communities may exhibit responses to water quality pollutants for which specific criteria or standards have not been defined, chemical analyses are not normally performed, or tolerance is below chemical detection limits.

DEQ's biological monitoring program examines over 150 stations annually. Reasons for bioassessments can include targeted monitoring, probabilistic monitoring, tracking local pollution events, follow-up on waters of concern identified through volunteer citizen monitoring and TMDL monitoring. Data from the biological monitoring program are used for periodic review and assessment of state waters as required by

Section 305(b) of the Clean Water Act. Biological monitoring is one tool used for assessing the aquatic life designated use of state waters established in 9 VAC 25-260-10 A. that states in part, "All state waters, including wetlands, are designated for the following uses: ...the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them..."

DEQ uses two bioassessment indices to assess the biotic integrity in non-tidal freshwater streams and rivers in Virginia. In the Coastal Plain, which is characterized by low gradient streams east of the fall line, the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) methodology is used. This multimetric index was developed in 1997 by the Mid-Atlantic Coastal Streams (MACS) workgroup. The VCPMI is a multimetric bioassessment index which was calibrated for low gradient Coastal Plain streams which exhibit different benthic macroinvertebrate communities from non-coastal stream communities.

For non-coastal streams, assessment of the benthic macroinvertebrate community is based on the Virginia Stream Condition Index (VSCI). The VSCI was developed for Virginia freshwater non-coastal streams by USEPA's contractor Tetra Tech, Inc. Using historical data collected in Virginia at reference and stressed streams from 1994-1998, Tetra Tech compared the historical data against additional data collected from 1999-2002. The VSCI is based upon recent advances in bioassessment methods contained in "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, Second Edition*" (Barbour et al. 1999). The VSCI, a multimetric calculation of benthic integrity converted into a single numerical score, resulted in a single reference condition for the entire non-coastal portion of the Commonwealth against which all future benthic samples will be compared. The development of this index is considered a significant step in the advancement of the biomonitoring program to address a wide range of monitoring and assessment needs. Based on recommendations from public comment and the Academic Advisory Committee, the VSCI was validated using a spatially diverse (ecoregionally and stream size) data set free of pseudoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the VSCI against many classification variables and confirm with certainty, the VSCI is a good assessment tool for Virginia streams.

Contact: For further information on the Freshwater Benthic Macroinvertebrate Monitoring Program contact:

Richard Browder
629 East Main Street
Richmond, Virginia 23219
(804) 698-4134
richard.browder@deq.virginia.gov

CHAPTER 3.2 ESTUARINE/COASTAL PROBABILISTIC MONITORING PROGRAM

Virginia's estuarine probabilistic monitoring module was initiated in the summer of 2000 with a five-year grant (CR-828544-01 – period 2000-2004) from EPA's "National Coastal Assessment (NCA) Program", formerly known as the "Coastal 2000 Initiative". This original, five-year effort was defined under the terms of a proposal titled "Monitoring the US Atlantic Coast: Assessing Virginia's Estuaries and Tidal Tributaries to the Chesapeake Bay and the Atlantic Ocean", submitted to the US-EPA in the spring of 2000. Specific field methodologies and Quality Assurance requirements of the Coastal 2000 / National Coastal Assessment Program are described in the EPA documents "[National Coastal Assessment Field Operations Manual](#)" (EPA 620/R-01/003) and "[National Coastal Assessment Quality Assurance Project Plan 2001-2004](#)" (EPA/620/R-01/002).

Purpose

The original goals of the National Coastal Assessment (Coastal 2000) Program were to:

- Assess the ecological condition of estuarine resources,

- Determine reference conditions for ecological responses/stressors, and
- Build infrastructure in EPA Regions and participating states.

Additional, more specific federal objectives were to:

- Assess the health or condition of the estuarine waters of the United States and track changes in that condition through time,
- Assess the health or condition of the estuarine waters of the various coastal states and track changes in that condition through time,
- Utilize the approach to identify reference conditions for estuarine waters in the United States, and
- Utilize existing state monitoring programs as appropriate

The geographic extent of the Estuarine/Coastal ProbMon Program is restricted to the eastern-most regions of the state. It is coordinated through the DEQ Central Office in Richmond and is carried out primarily by the Piedmont (PRO - Glen Allen) and Tidewater (TRO - Virginia Beach) Regional Offices. A few of the estuarine probabilistic sites (usually 1 or 2 sites annually) fall within the geographic jurisdiction of the Northern Regional Office (NRO) in Woodbridge.

At the state level, DEQ defined its agency goals and objectives relative to its comprehensive statewide Water Quality Monitoring (WQM) Program. Each participating DEQ region needs to complete its assigned probabilistic stations in order for DEQ to reach defensible conclusions about overall estuarine water quality from a statewide perspective.

Monitoring Design

The sampling strata for tidal tributaries have been geographically defined, by estuary size and drainage location, and a set of 50 randomly selected sampling sites are selected each year. In the past these were provided annually by the EPA/ORD Gulf Ecology Division (GED) Laboratory in Gulf Breeze, Florida (2000-2004), or the Atlantic Ecology Division (AED) Laboratory in Narragansett, Rhode Island (2005-2007) upon request. Since 2007 DEQ has performed its own site selection for the state sampling design using software provided by EPA/ORD/AED.

The two principal sampling strata in the state design consist of (1) small tidal tributaries to the Chesapeake Bay and its major tributaries and (2) tidal tributaries and embayments of the Atlantic coast and Back Bay/North Landing River (which discharge into Pamlico/Albemarle Sounds, North Carolina). The major tidal tributaries to the Chesapeake Bay (the Potomac, Rappahannock, York and James Rivers), as well as the Bay mainstem, are effectively characterized by the probabilistic monitoring of Virginia's Chesapeake Bay Program. Periodically (2000, 2005-06, and 2010), these larger waters were also included in the national survey sampling design for the purpose of integration into the standardized National Coastal Assessment (NCA) Program.

In the first year of sampling, 35 sites were selected in Virginia's portion of the Chesapeake Bay mainstem and the tidal portions of its major tributaries (Rappahannock River, York River, James River, & Elizabeth River - the tidal portions of the Potomac River mainstem are entirely in the state of Maryland). To better characterize smaller estuarine subdivisions, DEQ has in subsequent years (2001-2004) emphasized, and will continue to emphasize, minor tidal tributaries to the Chesapeake Bay, the Atlantic Ocean, and to Pamlico/Albemarle Sound by sampling at 50 sites annually. Virginia's participation in the interstate Chesapeake Bay Program already provides adequate probabilistic monitoring for the characterizations of the Chesapeake Bay mainstem and its major tidal tributaries (e.g., lower Potomac, James, York, and Rappahannock Rivers). The "weighting" of the current sampling design guarantees that each year approximately 70% of the sites (~35 stations) are selected in the Chesapeake Bay drainage and approximately 30% (~15 sites) are selected in coastal drainages. This assures that approximately 90 sites will be available to characterize the coastal estuary resource class by the end of each six-year period.

Core and Supplemental Water Quality Indicators

From 2001 through 2006, with the resources provided by EPA NCA/Coastal 2000 Grants, estuarine probabilistic stations were sampled for the complete suite of parameters described in the National Coastal Assessment QAPP cited above, as well as additional parameters utilized by the Chesapeake Bay Program. The total suite of water column parameters includes profiles of temperature, pH, DO, salinity and Photosynthetically Active Radiation (PAR), as well as samples for chlorophyll, nutrients and suspended solids measurements at near-surface, mid-depth and near-bottom. In addition, homogenized sediment samples are collected for local (DCLS) analyses of particle size and total organic carbon (TOC), as well as for metals and organic contaminant analyses and toxicity testing at EPA-contracted laboratories. A separate, 0.04 m² sediment sample is collected and sieved in the field for later identification of macroinvertebrate benthic infauna species to complete the "Sediment Quality Triad" (SQT) for "weight-of-evidence" ecological evaluations and assessments. In the past, EPA Grant funds also provided for the contracting of the Fisheries Science Laboratory at the Virginia Institute of Marine Science (VIMS) for fish trawls. These trawls were used to collect fish community-structure data, epibenthic organisms, incidental fish for pathological examinations, and targeted fish species for the analyses of metals and organic contaminants in whole fish tissues. Due to resource limitations, fish sampling is only included when additional funds are available for national surveys. Beginning in the summer of 2003, DEQ started supplementing the NCA core indicators with additional sampling for bacteria (fecal coliform, *E. coli*, and enterococci) and when resources permitted for dissolved and total trace metals.

Sample handling and shipping varies with the type of sample and its final destination for analysis. All samples are collected from boats anchored at the monitoring sites and are appropriately labeled and stored on wet ice at 4° C during transport to the responsible DEQ Regional Office. Samples to be analyzed at the Virginia State laboratory (DCLS) are maintained on ice and shipped daily to Richmond by overnight courier service. Such samples are received and processed within 24 hours of collection. Analyses are completed within the holding time specified in the pertinent QAPPs and EPA analytical method descriptions, after which the resultant data is entered into the DCLS LIMS system. Analytical results are subsequently transmitted to and permanently stored in the DEQ CEDS 2000 database on a daily basis. Turnaround time from sample arrival at DCLS to receipt of analytical data varies from 48 hours to 21 days, depending upon sample type.

Sediment samples that are analyzed chemically and toxicologically by other contracted laboratories are held under refrigeration at DEQ Regional Offices and are shipped to Richmond by courier on a weekly basis. Sediment toxicity samples are united and shipped weekly via overnight air to the contracted laboratory. Sediment chemistry samples are frozen and accumulated prior to shipping to the contracted laboratory. Typically, the sediment chemistry samples are delivered in two batches, one at the midpoint and one at the end of the sampling season. Benthic infauna samples are preserved in (10%) buffered formalin as soon as they are collected and are maintained at DEQ Regional Offices until the end of the field season (late September). They are then united at the DEQ Central Office and shipped to the Benthic Ecology Laboratory at Old Dominion University (ODU). Sediment chemistry and toxicity results are generally received by the end of the calendar year. The separation, identification and enumeration of benthic taxa require more time, and results from benthic analyses performed at ODU are normally available the following spring.

When included in the program, data related to fish community structure, epibenthic invertebrates, and habitat collected by VIMS trawl sampling are immediately entered into their onboard SAS database during the process of collection. Target fish species selected for chemical tissue analyses are individually labeled and wrapped and maintained on ice during transport to the laboratory. Once there, they are frozen and maintained until the end of the field season (October). They are shipped overnight, on dry ice, to EPA/GED for storage and later transshipment. Fish pathology specimens are maintained in Dietrich's solution until the end of the field season and are subsequently shipped to EPA/GED. Fish community, epibenthic macroinvertebrate and habitat data are united into a final report which VIMS sends to DEQ soon after the end of the field season in October or early November. Turnaround time for fish tissue chemical data and fish pathology data from EPA-contracted laboratories is currently at least two years.

Frequency/Duration

As is typical of probabilistic survey programs, monitoring sites are sampled only once and new sites are randomly selected each year. Under the conditions defined by the NCA QAPP, sampling occurs during the summer months from 1 July through 30 September. This period also coincides with the sampling “window” defined for the use of the Chesapeake Bay Program’s [“Benthic Index of Biological Integrity”](#) (B-IBI), which is utilized to evaluate the ecological health of the benthic community.

DEQ’s Estuarine Probabilistic Monitoring Program was proposed and developed as a major component of the agency’s Ambient Water Quality Monitoring Program and is fully implemented at this time. The resources formerly provided by the initial EPA Coastal 2000 Grant facilitated the implementation of the program in 2000 and terminated at the end of September 2004. A transitional National Coastal Assessment Grant provided funding at a reduced level during the 2005-2006 interim. Beginning in 2007, DEQ has continued the Estuarine ProbMon Program with a slightly reduced suite of parameters using supplemental probabilistic monitoring funds from federal §106 grants, complimented by Chesapeake Bay and general fund resources.

Quality Assurance Measures

DEQ’s field and laboratory activities adhere to QA/QC protocols specified in the [National Coastal Assessment Field Operations Manual](#) (EPA 620/R-01/003) and the [National Coastal Assessment Quality Assurance Project Plan 2001-2004](#) (EPA/620/R-01/002), except where specific variations have been authorized by the Regional NCA QA Officer. Authorized departures include the use of submerged pumps and hoses for the collection of subsurface water samples and vacuum field-filtration of nutrient and chlorophyll samples. Both of these procedures are specifically described in the corresponding sections of the contemporary QAPP and SOPs for Virginia’s Chesapeake Bay Monitoring Program.

DEQ requires that a minimum of 10% QA samples (field duplicates, field blanks, etc.) be collected at estuarine ProbMon field sites for all locally analyzed parameters. At present, one or two QA sites from among the 50 sites sampled are randomly selected annually for each of the three DEQ Regional Offices.

Data Management

Both samples and the resultant data collected within the Estuarine Probabilistic Monitoring Program follow diverse pathways. Standard procedures for the preservation, transportation and delivery of samples to the Virginia Division of Consolidated Laboratory Services (DCLS) and of sample shipment to other contracted laboratories were described above.

The data flow and data management for water and sediment samples analyzed by DCLS follow pathways and turnaround times as described for the WQM Program in general. Analytical results are quality assured by DCLS and stored in their LIMS database. Results that are complete and certified there are subsequently shipped electronically to the DEQ FTP site for upload into the CEDS 2000 database on a daily basis.

Currently, all data from locally (DCLS) analyzed samples reside in DEQ’s CEDS database. All analytical results receive a QA review at DCLS, prior to shipment to the DEQ database, and another QA review by programmed algorithms (data range screenings, etc.) within the CEDS database. Data that are ‘flagged’ by the automated screening procedures undergo an additional evaluation by DEQ’s QA Officer. Whatever questions arise concerning the location, date and time of samples arriving at DCLS, or about the accuracy of DCLS data transmitted to the CEDS database are resolved immediately via e-mail and voice communication between laboratory personnel and monitoring personnel at the DEQ Central or appropriate Regional Office.

Looking to the Future

The National Coastal Assessment Program (Coastal 2000 Initiative) was instituted by EPA’s Office of Research and Development (ORD) as an experimental program in 2000. The original five-year program was so successful and so well accepted by the participating coastal states that it was transferred to EPA’s Office

of Water (OW) as a permanent component of its national water quality monitoring strategy. An interim two-year grant supported the program (at a reduced level) during the 2005-2006 transition. Since then, the program has received partial support via the normal § 106 federal grant process.

Beginning in the summer of 2005, portions of the national design were coordinated with and integrated into the Chesapeake Bay Program's (CBP) probabilistic benthic monitoring program. Probabilistically-collected sediment-related parameters (sediment chemistry, sediment toxicity and benthic community structure – the 'Sediment Quality Triad' or SQT) from the minor tidal tributaries will supplement CBP efforts in the major tidal tributaries and mainstem of Chesapeake Bay. Use of the SQT facilitates the characterization and aquatic life use assessment of these minor tidal tributaries, where sample sizes are generally insufficient to apply the formal statistical assessment method utilized for the Benthic Index of Biological Integrity (B-IBI) in larger Chesapeake Bay assessment units (segments).

EPA carries out national probabilistic surveys on various aquatic resource classes on a five-year rotational basis. The last National Coastal Survey was performed in 2010. The most up-to-date NCA data can be found here: <http://www.epa.gov/emap/nca/html/data/index.html>.

Contact: For further information on the Estuarine Probabilistic Monitoring Program contact:

Donald H. Smith, Ph.D.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, Virginia 23219
(804) 698-4429
donald.smith@deg.virginia.gov

CHAPTER 3.3 ESTUARINE BENTHIC MACROINVERTEBRATE MONITORING PROGRAM

Benthic organisms are important secondary producers, providing key linkages between primary producers (phytoplankton) and higher trophic levels (crabs, bottom feeding fish and water birds). Benthic invertebrates are among the most important components of estuarine ecosystems and may represent the largest standing stock of organic carbon in the Chesapeake Bay. Some benthic organisms, such as hard clams and soft-shell clams, are economically important. Others, such as polychaete worms and shrimp-like crustaceans, contribute significantly to the diets of economically important blue crabs and bottom-feeding juvenile and adult fish such as spot, croaker, striped bass, and white perch.

The objectives of the Chesapeake Bay Estuarine Benthic Macroinvertebrate Monitoring Program are:

1. To characterize the health of regional areas of the lower Chesapeake Bay as indicated by the structure of the benthic community.
2. To conduct trend analyses on long-term data, at fixed- point stations, to relate temporal trends in the benthic communities to changes in water and/or sediment quality. The trend analyses will be updated annually as new data are available.
3. To warn of environmental degradation by producing an historical data base that will allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and trends at fixed-point stations to changes in water and/or sediment quality.

21 fixed-point stations are sampled one time per year (September) and there is one probabilistic summer sampling per year.

Contact: For further information on the Estuarine Benthic Macroinvertebrate Monitoring Program contact:

Cindy Johnson
629 East Main Street
Richmond, Virginia 23219
(804) 698-4385
cindy.johnson@deg.virginia.gov

CHAPTER 3.4 BEACH MONITORING PROGRAM - VIRGINIA DEPARTMENT OF HEALTH

Introduction

The “Beaches Environmental Assessment and Coastal Health (BEACH) Act” of 2000 amended Section 303 of the Federal Water Pollution Control Act (33 U.S.C. 1313) by specifying monitoring and reporting requirements for pathogens and pathogen indicators in coastal recreational waters for the purpose of protecting public health and welfare. One requirement of this Act was the publication of a list of “discrete coastal recreation waters adjacent to beaches or similar points of access that are used by the public.” The resultant “[National List of Beaches](http://water.epa.gov/type/oceb/beaches/list_index.cfm)” [http://water.epa.gov/type/oceb/beaches/list_index.cfm] was originally published by the U.S. EPA in 2004, and most recently in 2010. A current list of the beaches monitored in Virginia is available and cited below. The requirements of the BEACH Act apply only to states and tribes that have coastal recreational waters, defined by the Clean Water Act (Section 303(c) as the “...Great Lakes and marine and estuarine coastal waters that are designated by a state or tribe for use for swimming, bathing, surfing, or similar water contact activities...”

Virginia’s BEACH Monitoring Program [http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/] was initiated in 2002 by the Division of Environmental Epidemiology (DEE) of the Virginia Department of Health (VDH). In addition to the immediate reporting and public notification requirements relative to swimming advisories, results obtained by the VDH are communicated to DEQ for inclusion in the agency’s biennial 305(b)/303(d) Water Quality Assessment Reports. The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program were discussed by VDH and DEQ. The final decision on appropriate methodologies is incorporated into the 2016 Assessment Guidance Manual for the Integrated 305(b)/303(d) Report.

The BEACH Monitoring Program in Virginia is designed to provide seasonal monitoring of coastal and Chesapeake Bay beaches within the Commonwealth. A public bathing beach is defined by the Code of Virginia (1980, c.428, section 10-217, 10.1-705) as “a sandy beach located on a tidal shoreline suitable for bathing in a county, city or town and open to indefinite public use.” Based on these characteristics, 47 public beaches were identified prior to December of 2003, by which time their locations were communicated to EPA for the National List of Beaches. As of July 2004, these beaches were being monitored by the BEACH Program [VDH Beach Monitoring](#). Currently, 46 beaches in Virginia are monitored by the BEACH Program. The rationale for identifying and enumerating individual beaches is discussed below, in the section on ‘siting.’ The localities participating in this program include the cities of Virginia Beach, Norfolk, Hampton, and Newport News, as well as the counties of Mathews, York, King George, Gloucester, Northampton, and Accomack.

Purpose

The purpose of the program is to monitor fecal contamination of coastal beaches in an effort to reduce the risk of swimmers contracting disease or infection. Weekly monitoring is conducted to determine if levels of fecal indicator bacteria (enterococci) meet Virginia’s Water Quality Standards as described in Section 9 VAC 25-260 of the Virginia Administrative Code. The Standards are provisions of state law which consist of designated uses for the waters of the Commonwealth to protect public health or welfare, enhance the quality of water, and serve the purposes of the State Water Control Law and the Federal Clean Water Act.

Monitoring Design and Station Siting

The number of sampling stations at a beach is based on EPA guidance available at the following website:

<http://www.epa.gov/waterscience/beaches/grants/guidance/index.html>.

The rationale for siting and enumerating individual beaches is based on beach size and whether (1) it is small and is treated as a single entity for swimming advisories, or (2) if it is more extensive and individual sections may be placed under advisory independently. In summary, the current list of responsible health districts and beaches includes:

Rappahannock Health District (Fairview Beach) - 1 beach
Peninsula Health District (Newport News, York) - 5 beaches
Hampton City Department of Health - 3 beaches
Norfolk Department of Public Health - 10 beaches
Virginia Beach - 22 beaches
Three Rivers Health District (Gloucester, Mathews) - 2 beaches
Eastern Shore Health District (Accomack, Northampton) - 3 beaches

Total = 46 beaches

Samples are taken in the middle of a typical bathing area. If the beach is short, samples are taken at a point corresponding to each lifeguard chair or one sample for every 500 meters of beach. Sample results from several sites at the same beach may be united into a single arithmetic average for comparison with the Water Quality Standard and evaluation for swimming advisories, see below. If the beach is long (more than 5 miles) samples are spread out along the entire beach (e.g., Virginia Beach, which is 24 miles long, has 22 sampling stations spaced at least one mile apart). Locations of sites are identified by coordinates of latitude and longitude and remain uniform from year to year in order to maintain a permanent, long-term database on beach water quality.

The most updated information relative to the BEACH Monitoring Program, including maps of sampling sites, historical results, and swimming advisories, may be found on the [VDH BEACH Monitoring website](http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/). [http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/]. Beach monitoring and notification results are exported from the Beach Monitoring and Notification (BMAN) database weekly during the season and posted to the website [Monitoring And Advisory Data By Year](#). Data for prior years may also be reviewed on this page.

Frequency

Beaches are sampled for fecal indicator bacteria on a weekly basis from mid-May through September. When the Water Quality Standard at a specific beach is exceeded, or when the results of bacterial analysis are inconclusive, follow-up sampling is repeated as soon as possible.

Sampling

As per EPA guidance, samples are collected 0.3 meters below the surface in water knee-deep water. VDH's 2012 Quality Assurance Project Plan provides general guidelines for sampling procedures. Samples are placed on ice and are delivered to the laboratory for processing within six hours of collection.

Samples are collected on the regular monitoring day, rain or shine, unless conditions are dangerous to sampling staff. If a decision is made not to sample because a violation of the standard is expected (e.g., heavy storm drain overflow), the beach is posted with a swimming advisory. Samples are collected and transported in the same way at all sites. All samples are grab samples, using sterile bottles that are supplied by the laboratory performing analysis.

When continued exceedances of the water quality standard occur at monitoring locations, samples may be collected for microbial source tracking analysis by the Hampton Roads Sanitation District (HRSD). The results of this analysis provide an indication of the source of fecal pollution. Varying sources of fecal pollution have shown to provide different levels of health risk to water users. Also, some sources of fecal

pollution can be remediated.

Duration

Beach monitoring sites are considered permanent, fixed sites of the VDH BEACH Monitoring Program. Sampling will continue as long as funding is available. As mentioned above, the sampling is conducted from mid-May through the September swimming season.

Core and Supplemental Water Quality Indicators

The fecal indicator organism used for estuarine and marine beaches are bacteria of the genus *Enterococcus*. Laboratory analysis of enterococci in beach water samples is conducted using EPA approved methods. Additional measurements of air and water temperature, turbidity, dissolved oxygen, pH and salinity are also taken at beach sites during each visit.

Quality Assurance

VDH's Quality Assurance Project Plan was updated and approved by EPA in November 2012. Sampling methods are based on sections 9060 and 9060B of Standard Methods for the Examination of Water and Wastewater (APHA 2012). Standard procedures for laboratory analyses of water samples for enterococci are produced by the laboratories performing the service and are also included in the Quality Assurance Project Plan.

Annual training is provided for all field personnel and their supervisors. Training consists of sample collection and handling, data management, results interpretation, operation and calibration of equipment, and current program issues, updates, and quality assurance objectives.

Data Management

VDH receives weekly results from laboratories by email, fax, and/or conventional mail. Timely data submission is emphasized so that the VDH BEACH Monitoring website can be updated as soon as results are available. Timely data submission is mostly critical when exceedances of the Water Quality Standard occur and swimming advisories need to be issued. Upon receipt of results, VDH local health district staff enters laboratory results into a VDH database. When results are entered, swimming advisories are posted on VDH's Beach Advisory Map and Twitter (@VDHBeach) for public notification.

Data are periodically sent to EPA, via CDX for STORET, in an XML schema utilizing formats specified in [EPA's Beach Monitoring Data User Guide](#).

Data Analysis/Assessment

Swimming Advisories: VDH compares beach water sample results with Virginia's Water Quality Standard for enterococci. The results from several simultaneously collected samples at the same beach may be united into a single arithmetic average for comparison with the Standard, and for subsequent evaluation for issuing swimming advisories. The Single Sample Maximum for enterococci is 104 colony forming units (cfu)/100ml. Samples above this level are in violation of the Virginia Water Quality Standards. One sample exceedance of the Single Sample Maximum standard is sufficient to issue a swimming advisory.

If there is a violation of the Standard, the beach is posted with a swimming advisory sign and procedures for contacting the locality where the beach is located are followed. A press release is issued to notify the public, and a follow-up water sample is collected and delivered to the lab as soon as possible. Procedures for this process are documented in the VDH's Quality Assurance Project Plan.

305(b)/303(d) Assessment and Reporting: The specific 305(b) assessment methodologies for using (1)

swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program was discussed by VDH and DEQ. As previously stated, the final decision on appropriate methodologies is incorporated into the DEQ Assessment Guidance Manual for the 2016 Integrated 305(b)/303(d) Report.

Reporting

If sample results exceed the Water Quality Standard, the beach is posted with a swimming advisory sign, the public is notified through press releases to local newspapers, and an advisory is posted on the VDH [Beach Advisory Map](http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/swimming-advisories-and-monitored-beaches-map/) [http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/swimming-advisories-and-monitored-beaches-map/] and on the @VDHBeach Twitter page.

Sample results and public notification data are submitted to EPA annually as required. Data collected by the BEACH Monitoring Program are available to DEQ for use in the agency's biennial Integrated 305(b)/303(d) Report via STORET (EPA database).

Programmatic Evaluation

VDH participates in biweekly conference calls and annual meetings with EPA to review the BEACH Monitoring Program in Virginia. The program is grant funded, and reviews of the yearly proposals, progress reports, and database submissions are mechanisms for programmatic evaluation by EPA. Within VDH, there is routine communication between the Division of Environmental Epidemiology and the participating health districts, and weekly reviews of data from each participating health district are performed by VDH's BEACH Coordinator and/or support staff.

General Support and Infrastructure Planning

The BEACH Monitoring Program is a federally funded program. Yearly budgets are prepared in advance to meet proposal submission deadlines established by EPA. Future changes in methodologies will depend upon EPA recommendations, and expansion of the current program may occur in response to the opening of new public beaches or their identification by local health districts.

Contact: For further information on the BEACH Monitoring Program contact:

Margaret Smigo
Waterborne Pathogens Control Program Coordinator
VDH, Office of Epidemiology
109 Governor Street, 6th Floor
Richmond, Virginia 23219
(804) 864-8128
Margaret.Smigo@vdh.virginia.gov

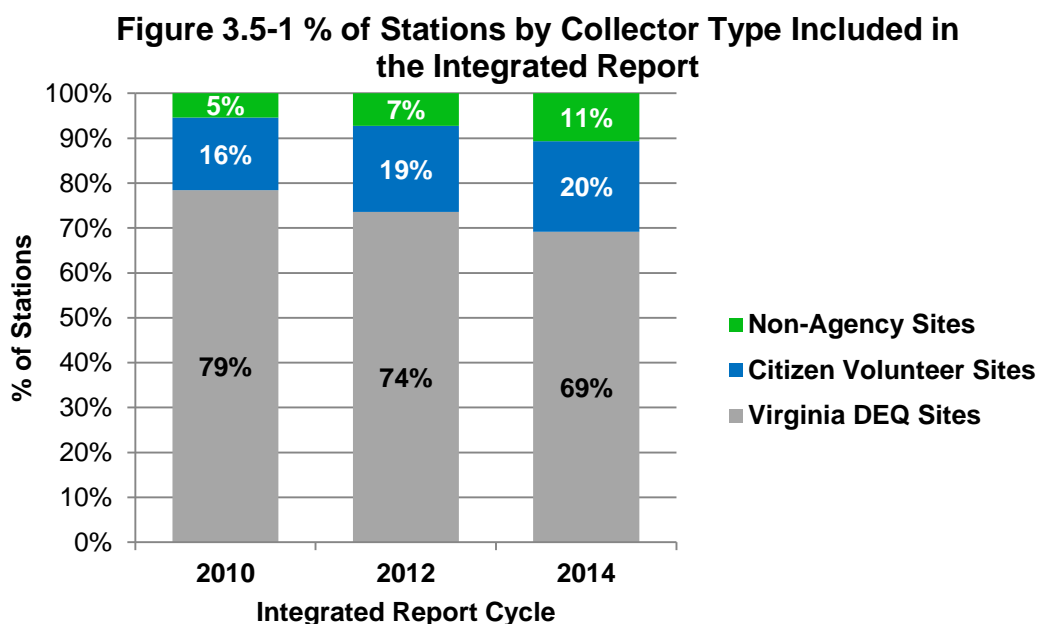
CHAPTER 3.5 CITIZEN AND NON-AGENCY WATER QUALITY MONITORING PROGRAM

Citizen water quality monitoring has been a stewardship activity in Virginia for many years. As both the volume and quality of water monitoring data collected by entities other than the Virginia Department of Environmental Quality (DEQ) has increased, so has the desire by many of these 'non-agency' organizations for DEQ to use submitted data for more than background information in Virginia's water quality assessments. Since 1999, the agency has encouraged citizen water quality monitoring by providing technical and, whenever possible, financial support. In addition to support for citizen monitoring, the agency has been actively attempting to expand our partnerships with an increasing number of other water quality monitoring programs that operate independently of DEQ. It is important to note that while efforts are being made to utilize more non-DEQ monitoring data in assessing the quality of Virginia's surface water resources, this type of data cannot be used as evidence in any enforcement action, per a limitation in Virginia Code ([§ 62.1-44.19:11](#)).

Starting with the 2004 water quality assessment report, DEQ began using chemical monitoring data collected by citizen groups and other non-agency sources provided such data met DEQ Quality Assurance and Quality Control (QA/QC) protocols for determination of attainment of Water Quality Standards. This QA/QC process confirms whether citizen organizations and other non-agency data sources are using the same or similar sampling and testing methods that DEQ uses, ensuring that comparable data are used in any applications that include data from these sources.

In August 2004 DEQ created the Water Quality Data Liaison staff position. The purpose of the position is to provide guidance and technical support to citizen monitoring organizations, facilitate communication among citizen and non-agency water monitoring organizations, promote establishing new monitoring groups, and increase the amount and improve the quality of data shared with DEQ.

Since the 2004 water quality assessment report the amount of water quality data submitted to the agency has increased. This can be seen in the table below. The table compares the number of non-DEQ monitored sites to what the agency monitors during the previous three assessment cycles.



Quality Assurance:

Currently, DEQ has contacts with over 200 citizen and other monitoring organizations. During this assessment cycle, the agency received data from over 75 organizations. The vast majority of data used in this report was collected under documented protocols, standard operating procedures, and QA/QC methods as approved or recognized by DEQ for water quality assessment. Data collected using unconfirmed protocols or where sampling occurred on waters not publically accessible such as on privately owned lakes were not used in this assessment. However such data may be useful to DEQ, and other agencies, to help prioritize future monitoring and restoration work. Additional information on how submitted data was assessed is available in the 2016 Water Quality Assessment Guidance Manual: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx>

In order to assist citizen water quality monitoring groups with developing their monitoring programs, the agency developed the *Virginia Citizen Water Quality Monitoring Methods Manual*. The manual provides additional guidance on acceptable QA/QC procedures and protocols. A copy of this manual is available on the DEQ website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/Guidance.aspx>. In addition the agency has developed additional materials for popular methods such as the Coliscan Easygel protocol and example quality assurance project plans.

As outlined in the *Virginia Citizen Water Quality Monitoring Methods Manual*, DEQ has three levels to determine the quality of citizen and other non-agency water monitoring data. These levels increase in rank from Level I to Level III based on increasing levels of DEQ approved QA/QC protocols. Definitions of each level and how groups can achieve each of them are outlined below.

Level I - Not approved by DEQ for assessment. There is no Quality Assurance Project Plan (QAPP) or Standard Operational Procedures (SOP) on file. Monitoring and/or laboratory analysis does not follow DEQ sampling methods or quality assurance protocols or monitor for parameters that do not have a Virginia Water Quality Standard (<http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards.aspx>).

- Data used by DEQ to identify sites that may require DEQ to perform follow-up monitoring.
- Data used for educational or outreach purposes.
- Data can notify DEQ of significant pollution events for rapid agency response.

Level II - Partially approved by DEQ. May be using a monitoring method similar to DEQ protocols but not fully approved by DEQ due to difference in sampling or testing methodology. The monitoring group may have a DEQ approved QAPP and/or SOP on file.

- All uses as stated in Level I
- Used for 305(b) assessment to identify possible waters with observed effects or waters that appear to be healthy but will need DEQ monitoring data to confirm status (Category 3C or 3D).

Level III - Approved by DEQ. Group follows DEQ testing protocols and quality assurance. Field sampling and laboratory testing protocols are approved by DEQ or DEQ approved accrediting authority. Group possesses a DEQ approved QAPP and SOP with no deviation from DEQ approved standardized methods (EPA methods, Standard Methods, etc.). Finally, the group must provide calibration and quality control associated information to DEQ when submitting data. This information must meet the specific criteria stated in the QAPP.

- All uses as stated in Level II
- DEQ views this level of data as if DEQ had collected and analyzed the sample. Data that meets Level III criteria will be used in the 305(b) water quality assessment and for 303(d) listing/delisting of impaired waters.

Citizen Monitoring:

Citizens of the Commonwealth monitor streams, lakes, and estuaries for a variety of parameters depending upon the goals of their own programs. Common ambient measures include many of the following physical and chemical parameters: water temperature, pH, dissolved oxygen, nutrients (various forms of nitrogen and phosphorus), or suspended solids in the water column. Biological parameters measured by citizen monitors often include benthic macroinvertebrates, *E. coli* bacteria, or chlorophyll *a*. Many of these parameters are routinely monitored by DEQ.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) took the lead in working with DEQ and the Department of Conservation and Recreation (DCR) to develop a statewide citizen monitoring program. This started with three separate letters of agreement signed by each agency in 1998 and was furthered by a three-way agreement signed in 1999. The latest version of the agreement, signed in November 2015, includes the Alliance for the Chesapeake Bay, Virginia Citizens for Water Quality and the Virginia Water Monitoring Council in addition to the original signatories from 1999.

Citizen monitoring efforts in Virginia received an additional boost in 1999 when the Virginia General Assembly approved a budget amendment to create the Citizen Water Quality Monitoring Grant Program in order to provide general funds, when available, for citizen monitoring activities. Since 1999, the Citizen Monitoring Grant Program has provided funding to over 100 different organizations. The financial support provided by the Commonwealth via this grant program has led to an increase in the quality and quantity of citizen-collected data submitted to DEQ and has proved an effective way for DEQ to encourage citizen volunteer groups to generate DEQ-approved water quality data. The grant requires recipients to submit Quality Assurance Project Plans (QAPP) and to follow DEQ approved procedures. In return, the grant recipient receives a grant award to help cover many of the costs associated with their monitoring programs.

In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water Quality Monitoring Program in the Code of Virginia ([§62.1-44.19:11](#)). This legislation was later amended in 2007 under House Bill 1859 to establish a goal for DEQ to encourage citizen volunteers to monitor 3,000 stream miles by 2010. This goal was met during the 2010 305(b)/303(d) Integrated Report where 3,499 stream and for the 2014 report, 3,642 miles were monitored by volunteers.

For the 2016 assessment report, DEQ received citizen monitoring data from 1,902 sites. None of these sites met Level I requirements for all submitted parameters, 719 sites met Level II, and 916 sites met Level III for at least one water quality parameter. Of these 1,902 Level II and III stations, 128 had either missing sample site coordinates or were located in non-assessable locations such as at permitted wastewater outfalls. This assessment cycle marks the highest ever number of total number of citizen stations sampled and Level III citizen volunteer stations included in a Virginia 305(b)/303(d) Integrated Report.

Summary of Citizen Data Submissions: For the 2016 305(b)/303(d) Integrated Water Quality Assessment Report, the following citizen monitoring organizations submitted water quality data to DEQ:

Alliance for the Chesapeake Bay	Goose Creek Association	Phi Theta Kappa
Blackwater Riverkeeper	Historic Green Springs Inc.	Poquoson Citizens for the Environment
Chesapeake Beach Civic League	Hoffler Creek Wildlife Refuge	Prince William SWCD
Chesterfield WaterTrends	Isle of Wight Ruritan Club	Randolph Macon College
Chickahominy Swamp Rats	James River Association	RappFLOW
Clean Virginia Waterways	John Marshall SWCD	Rippon Middle School
Coast Guard Auxiliary Flotilla 33	Lake Anna Civic Association	Riverine Chapter VMN
Cowpasture River Preservation Association	Lake Gaston Association	Roanoke Valley Trout Unlimited
Cubitt Creek Monitors	Lake Monticello Owners Association	Smith Mountain Lake Association
Dividing Creek Association	Leesville Lake Association	Southeast CARE Coalition
Fairview Beach Residents Association	Lewis Ginter Botanical Gardens	Southern Appalachian Mountain Stewards
Four Creeks Monitors	Loudoun Watershed Watch	Southside SWCD
Fredericksburg Area Monitors for the Environment	McClure Restoration Project	Stream Watch
Friends of Norfolk Environment	Nansemond River Preservation Alliance	Thomas Jefferson SWCD
Friends of the NF Shenandoah River	New River Conservancy	Upper Tennessee River Roundtable
Friends of the Russell Fork	Northern Neck SWCD	Virginia Aquarium and Marine Science Center
Friends of the Shenandoah River	Pebble Creek Property Owners Association	VA Save Our Streams
George Mason High School	Peninsula Chapter Virginia Master Naturalists	

The Alliance for the Chesapeake Bay submitted ambient (chemical and physical) data collected by the following affiliate organizations:

City of Richmond	James River Chapter Virginia Master Naturalists	Reedy Creek Coalition
Friends of the Rappahannock Chemical Monitoring Program	Lynchburg Area Volunteers	Riverine Chapter Virginia Master Naturalists
Green Aquia	Northern Neck Chapter Virginia Master Naturalists	

The Friends of the Shenandoah River submitted ambient (chemical and physical) data collected by the following affiliate organizations:

Augusta River Monitors	Friends of the North Fork Shenandoah River	Opequon Watershed Inc.
Friends of Page Valley	Friends of the Shenandoah River	Warren County Water Monitoring Group

The VA SOS program is the largest citizen and benthic macroinvertebrate monitoring program in Virginia. The VA SOS Modified Rocky Bottom Method protocol determines the benthic community health in higher gradient streams with riffles typical to those found in the western part of Virginia. DEQ and VA SOS consider the data submitted to be Level II because it provides general information on the overall health of

a benthic community.

In response to requests from citizens located in the eastern part of Virginia, VA SOS also developed a protocol for low gradient, freshwater, non-tidal streams. At the time of this report, DEQ has not approved the low gradient freshwater streams for QA Level II or III.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America submitted benthic macroinvertebrate data collected by the following affiliate organizations:

Albemarle County	Friends of the Rockfish Watershed	Pedlar River Institute
Amelia County Landfill	Goose Creek Association	Pound River Watershed Coalition
Blackwater SOS	Grundy High School	Prince William SWCD
Bluestone Watershed Committee	Roanoke Valley Governor's School	Radford University Green Team
Buchanan Citizens Action Group	Headwaters Association	RappFLOW
Buckingham Citizen Action League	Holston River Water Quality Monitors	Reston Association
Clinch Coalition	Hungry Mother State Park	Rivanna Conservation Society
Clinch Valley SWCD	Independence High School	Riverine Chapter of the Virginia Master Naturalists
Cowpasture River Preservation Association	John Marshall SWCD	Roanoke Valley Monitors
Culpeper SWCD	Kittrell Stream Team	Shenandoah Valley SWCD
Dan River Basin Association	Lake Anna Civic Association	Shenandoah University
Douthat State Park	Lord Botetourt High School	Smith Mountain Lake Association
Elliott Creek Watershed Protection Council	Loudoun Watershed Watch	Southwest Virginia Community College
Emory and Henry College	Loudoun Wildlife Conservancy	StreamWatch
Environmental Education Center	Maury River Middle School	Upper James River Roundtable
Environmentally Concerned Citizens Organization	Maury River Monitors	Upper Rappahannock Watershed Stream Monitoring Program
Ferrum College Dream Stream Team	Mountain Stream Stewards	Upper Tennessee Roundtable
Franklin County Master Naturalists	Middle River Monitors	Virginia Run Home Owners Association
Friends of Accotink creek	New River SWCD	Virginia's Explore Park
Friends of the Middle River	North Cross School	Virginia Tech
Friends of the North Fork of the Shenandoah River	Northern Virginia SWCD	Virginia Master Naturalists
Friends of the North River	North Virginia Chapter of Trout Unlimited	Walker Creek Watershed Group
Friends of the Rappahannock River	Oakbrook Stewards of Creation	Warren County Chapter of the Izaak Walton League
Friends of Page Valley	Patrick County Monitors	Washington and Lee University
Friends of the Pedlar River	Patrick County SWCD	

Below is an alphabetical summary of the water quality data contributions by citizen monitoring organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The **Alliance for the Chesapeake Bay** (ACB) coordinates with affiliate organizations primarily in the eastern half of Virginia. ACB volunteers monitor a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, salinity, and water clarity. Trained volunteers monitored at 81

stations and collected 2,123 sample events during the six-year data window for this report. Most dissolved oxygen, pH, and temperature data met DEQ quality assurance criteria to assess water quality conditions. . Of the submitted data, 7 sample sites composed of 49 sample events were not included in this assessment report due to having an unknown station location.

The **Blackwater/Nottoway Riverkeeper Program** (BNRP) is an organization that helps educate and promote environmental stewardship in the Blackwater and Nottoway Rivers. As part of this education and stewardship effort, the BNRP conducts routine monitoring for temperature, pH, dissolved oxygen, nutrients, and *E. coli* at 12 stations in several counties in southeastern Virginia. DEQ has received 220 sampling events for the 2016 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

The **Chesapeake Beach Civic League** conducts routine monitoring for temperature, pH, *E. coli*, and nutrients. The volunteers monitor at 14 locations covering 286 sampling events on 5 privately owned lakes. Because the lakes are not publically accessible, the data is not included in the 305(b)/303(d) assessment report. However, DEQ has been working with the volunteers to provide an informal assessment of water quality conditions at each of the monitored lakes. This information is being used to help educate homeowners on sustainable land use practices.

Chesterfield WaterTrends is a volunteer water monitoring program coordinated by Chesterfield County Department of Environmental Engineering, conducts routine monitoring in the James River for temperature, pH, dissolved oxygen, *E. coli* bacteria, and turbidity. Chesterfield WaterTrends has 57 sampling stations. DEQ has received 1802 sampling events for the 2016 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

Chickahominy Swamp Rats is a small organization founded in response to a number of bacteria impaired waters in the Chickahominy River watershed. In 2013, the organization monitored 22 locations for a total of 145 sampling events to gauge *E. coli* levels using the Coliscan Easygel method. The results were submitted to determine if DEQ follow-up sampling is necessary.

Clean Virginia Waterways, in partnership with Longwood University, collected 788 *E. coli* samples from 21 stations along the Appomattox River as part of the Appomattox River Water Quality Monitoring Program. Upon review of sampling and laboratory procedures, DEQ will directly assess monitored waters using the *E. coli* results.

Coast Guard Auxiliary Flotilla 33, a volunteer branch of the United States Coast Guard, conducts routine monitoring for depth, temperature, pH, dissolved oxygen, and conductivity. The group sampled at 7 stations in the Chesapeake Bay stations. DEQ has received 14 sampling events for the 2016 305(b)/303(d) Integrated Report. DEQ will use this data to assess monitored waters.

The **Cowpasture River Preservation Association** the DEQ received data from 20 stations comprising of 505 sampling events during this assessment cycle. The agency determined submitted dissolved oxygen, pH, temperature and *E. coli* is suitable to determine if follow up sampling is needed and gauge TMDL implementation progress. Nutrient and conductivity readings were not assessed due to lack of water quality standards and the type of monitoring equipment used. .

The **Cubitt Creek Monitors** collected 70 samples for temperature and *E. coli* at 10 stations in Cubitt Creek. Submitted data will be used to determine the need for additional follow-up monitoring by DEQ.

The **Dividing Creek Association** (DCA) has been an active monitoring and stewardship organization located on Dividing Creek near Kilmarnock, Virginia. Since 2008, DCA has begun an enhanced monitoring program and submitted data from 50 stations consisting of 1261 sample events. By following DEQ recognized protocols, DEQ will utilize temperature, dissolved oxygen, and pH data for assessing the health of Dividing Creek. .

Fairview Beach Residents Association collects *E. coli* samples using the Coliscan Easygel method.

DEQ received data from 69 stations comprised of 171 sampling events. The bacteria results will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

Four Creeks Monitors collected dissolved oxygen, pH, and water temperature data using DEQ approved protocols. *E. coli* samples were collected using the Coliscan Easygel method and will be used to determine if follow up sampling is needed and track TMDL implementation progress. . DEQ received data from 16 stations comprised of 258 sampling events.

Fredericksburg Area Monitoring for the Environment (FAME) was found in 2014 by the Tri-County City Soil and Water Conservation District and monitors for *E. coli* using the Coliscan Easygel method. The group monitored 8 sites for a total of 30 sample events. The DEQ will use the FAME results to determine if follow up sampling is required and track local TMDL implementation progress.

Friends of Norfolk Environment collected Enterococcus samples at 11 stations comprising of 132 sample events during 2010. Old Dominion University performed the analysis and the data will be used by DEQ to assess recreation related water quality standards at the monitoring locations.

Friends of the North Fork of the Shenandoah River (FNSR) are an affiliated group with the Friends of Shenandoah River. Along with the routine monitoring done under the larger Friends of Shenandoah River and Virginia Save Our Streams programs, FNSR collected 98 nutrient, *E. coli* and field parameter samples at 8 stations. Of the submitted data, 2 sample sites composed of 16 sample events were not included in this assessment report due to being located within VPDES permitted mixing zones.

Friends of Russell Fork monitored 19 stations and collected 324 *E. coli* and temperature readings. The data will help DEQ determine the need for additional monitoring by DEQ in the waterbodies sampled by this group.

The **Friends of the Shenandoah River (FOSR)** monitors ambient water quality for dissolved oxygen, pH, temperature, ammonia, nitrate, and orthophosphate in the Shenandoah River subbasin. From 2009 to 2014, FOSR collected 12,050 sample events from 224 stations. Of the submitted data, 79 sample sites composed of 1135 sample events were not included in this assessment report due to missing site coordinates or located within VPDES permitted mixing zones. DEQ is assessing FOSR data for ammonia, dissolved oxygen, *E. coli* bacteria, pH, and temperature in sampled waterbodies. The parameter nitrate is only assessed in waters designated for drinking water in this report as nitrate only has a drinking water quality standard.

George Mason High School students collected *E. coli* samples using the Coliscan Easygel method at four stations. From the start of the monitoring in February 2009 to December 2014, the students collected 112 samples. The data will help DEQ in identifying areas for future agency sampling.

The **Goose Creek Association (GCA)** collected 221 water chemistry and *E. coli* samples at 34 stations over the course of this reporting period. GCA volunteers also collected benthic macroinvertebrate data using Virginia Save Our Streams protocols and submitted to DEQ via Virginia Save Our Streams. DEQ will use the dissolved oxygen, pH and *E. coli* data to determine if follow-up monitoring is needed. Temperature data will be assessed to indicate if the sampling stations are showing water quality attainment or impairment.

The **Historic Green Springs, Inc.** conducted monitoring in the York River Basin for temperature, pH, nutrients, and total suspended solids. Trained volunteers monitored seven stations and conducted 44 sampling events at 7 stations in this basin during the data window for this assessment. Temperature, dissolved oxygen, nutrient data meeting QA/QC requirements were used to assess water quality. Total suspended solids, and pH data was used to determine if follow-up monitoring is needed.

Hoffler Creek Wildlife Foundation volunteers collected 72 dissolved oxygen, pH, and temperature samples at one site during 2009 to 2012. Data is being used to determine the need for future follow up sampling by DEQ.

The **Isle of Wight Ruritan Club** has been conducting water quality sampling at three stations. From February 2009 to December 2014, volunteers monitored on 169 occasions at 13 stations for temperature and dissolved oxygen to assess water quality. The additional parameters monitoring including pH and *E. coli* bacteria will be used by the agency to identify need to do follow up monitoring.

James River Association (JRA) established the James River Watch program in 2013. Monitors collect weekly samples between Labor Day and Memorial Day with an emphasis on collecting *E. coli* samples using the Coliscan Easygel method to gauge recreational contact of swimmers at locations not frequently monitored by other organizations. In addition monitors collect temperature and turbidity readings while sampling. JRA volunteers sampled at 10 locations a total of 141 sample events. Temperature data will be used by DEQ to assess the monitored waters. *E. coli* results will be used to determine if follow-up sampling is required while turbidity is not assessed due to a lack of a Virginia water quality standard.

The **John Marshall Soil and Water Conservation District** (JMSWCD) conducted 1,762 sampling events at 35 sites in Fauquier County. JMSWCD volunteers collected samples to test for *E. coli* using Coliscan and sampled for temperature, dissolved oxygen, pH, and nutrients. The purpose of monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ included the submitted data included the Coliscan results for Category 3C and 3D to determine if follow-up monitoring is needed.

The **Lake Anna Civic Association** collected samples on Lake Anna and its tributaries using a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, *E. coli*, total phosphorus, and water clarity. Trained volunteers monitored 45 stations and conducted 863 sampling events in this basin during the data window for this report. Of the submitted data, 5 stations comprising of 120 sample events were not assessed as they are located in VPDES permitted mixing zones. DEQ is assessing the remaining data for chlorophyll a, dissolved oxygen, pH, temperature, total phosphorous, and *E. coli* for this report.

The **Lake Gaston Association** began *E. coli* sampling using the Coliscan Easygel method in 2013. Volunteers monitored 2 locations on the Virginia side of Lake Gaston for at total of 8 sampling events. Results will be used to determine if follow-up sampling is necessary.

The **Lake Monticello Owners Association** monitors 15 stations around Lake Monticello, a privately owned lake in the Rivanna subbasin. From May 2009 to October 2014, the volunteers monitored 68 sample events sampling for pH, dissolved oxygen, temperature, conductivity, nutrients, *E. coli* bacteria, and water clarity. Because the monitoring is on a lake not considered a publicly accessible waterbody, DEQ did not assess the data as part of this 305(b)/303(d) report. However, DEQ has conducted a review of the results and is working with the association to provide guidance to modify their monitoring program and provide an informal water quality assessment of lake conditions.

The **Leesville Lake Association** (LLA) include a group of volunteers committed to monitor and promote the environmental needs of Leesville Lake located just downstream of Smith Mountain Lake. LLA volunteers in partnership with Liberty University have monitored 11 stations covering 366 sample events. Though this monitoring, DEQ will assess data for temperature, dissolved oxygen, *E. coli*, and pH. In addition, DEQ will use provided *E. coli* data via the Coliscan Easygel method to determine if follow-up bacteria monitoring is necessary.

Lewis Ginter Botanical Garden established a water monitoring program in 2013 to gauge water quality as it enters and leaves the property. Monitors sampled for dissolved oxygen, temperature, and pH using electronic probes and met DEQ protocols for direct assessment. The volunteers and staff also monitored for *E. coli* using Coliscan Easygel and will be used to determine if follow-up sampling is required by DEQ. Finally volunteers sampled for and nitrate and orthophosphate using a Hach spectrophotometer and was not assessed due to no water quality standard to assess the results. A total of 9 locations a total of 159 times. 5 sites that were sampled 80 times were not assessed due to sampling in privately owned ponds.

Loudoun Watershed Watch collects *E. coli* samples using the Coliscan Easygel method and benthic

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macroinvertebrate results using the Virginia Save Our Stream method in the Potomac watershed. DEQ received data from 13 stations comprised of 93 sampling events. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The **McClure River Restoration Project (MRRP)** is conducting an intensive *E. coli* monitoring program in the McClure River watershed. DEQ has received data from 24 stations composed of 640 sample events during the assessment cycle. Based on reviewing sampling and laboratory protocols, DEQ will use the data to assess water quality.

Nansemond River Preservation Alliance conducts routine monitoring for temperature, dissolved oxygen, salinity, water clarity, and *E. coli* at 9 stations in the James River. DEQ has received data from 244 sampling events and will use the results to assess water quality for temperature and dissolved oxygen. *E. coli*, water clarity, and salinity will not be assessed due to a lack of an associated water quality standard.

The **National Committee for the New River (NCNR)** began monitoring at 35 locations in the New River watershed in May of 2008. Since then, NCNR volunteers have monitored 416 sample events. Volunteers sampled for temperature, dissolved oxygen, pH, *E. coli* bacteria, and water clarity. DEQ will use the temperature, and dissolved oxygen to assess water quality at these locations. The *E. coli* and pH results will be used to determine if follow-up monitoring is necessary due to the volunteers using the Coliscan Easygel method and field pH test kits.

The **Northern Neck Soil and Water Conservation District** began Coliscan Easygel to sample for *E. coli* at several waterbodies that had a bacteria TMDL impairment to help identify potential sources. Monitoring began in December 2012 with 4 samples collected at 4 locations. Due to the insufficient number of samples received during the assessment cycle.

The **Pebble Creek Property Owners Association** collected temperature and *E. coli* samples at 4 stations in the James River. DEQ received 26 sampling events and will use the information to determine if follow up monitoring is needed.

The **Peninsula Chapter Virginia Master Naturalists** monitored at 4 locations 51 times during the assessment cycle. Volunteers sampled for *E. coli* using Coliscan Easygel, water temperature, salinity and water clarity. Temperature data met DEQ quality assurance standards to be used to assess monitored waters. *E. coli* will be used to determine if follow-up sampling is required. Salinity and water clarity data were not assessed due to a lack of water quality standards for Virginia waters.

The **Phi Theta Kappa Chapter of the Blue Ridge Community College** collected pH, *E. coli*, and temperature data from two stations in 2010. Results from the 24 sample events will be used to determine the need for additional agency sampling for future monitoring.

Poquoson Citizens for the Environment (PCE) has been conducting temperature, pH, and *E. coli* sampling at 26 stations since January 2009. This sampling program sampled 346 times and submitted results to DEQ. Based on the protocols used by PCE, DEQ will use the pH and temperature data to assess water quality and *E. coli* data to determine if follow up monitoring is necessary due to using the Coliscan Easygel method.

The **Prince William Soil and Water Conservation District** collected 251 *E. coli* samples at 17 locations using the Coliscan Easygel method. The data is being used by DEQ to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

Randolph Macon College located in Ashland, Virginia, has used Coliscan test kits to monitor nearby Mechumps Run. Students collected 41 *E. coli* samples at 10 sites in an effort to assist DEQ in finding areas of high *E. coli* concentrations and to track TMDL implementation efforts. Based on training and technical assistance provided by DEQ, the agency is using the data to determine if follow-up monitoring is needed.

The **Rappahannock Friends and Lovers of Our Watershed** (RappFLOW) performed 24 sample events at 12 stations for temperature, and *E. coli* bacteria from April to June 2009. Upon review of calibration logs and other quality assurance materials, DEQ used the data in this assessment to determine if follow-up monitoring is needed.

Rippon Middle School collected *E. coli* samples using the Coliscan Easygel method in the Potomac/Shenandoah River. DEQ received data from 6 stations comprised of 21 sampling events. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The **Riverine Chapter of the Virginia Master Naturalists** began monitoring in March 2009. Volunteers collected 104 samples for dissolved oxygen, *E. coli*, pH, and temperature at six stations. Submitted data will be used by DEQ to determine the need for future agency sampling.

Roanoke Valley Trout Unlimited collects temperature and *E. coli* samples using the Coliscan Easygel method in the Roanoke River. DEQ received data from 10 stations comprised of 30 sampling events. Temperature data will be used for assessment. The *E. coli* results will be used to determine the need for additional agency sampling.

The **Smith Mountain Lake Association** (SMLA) and Ferrum College have partnered for many years to monitor water quality in and around Smith Mountain Lake. Currently the organization has Level III status for temperature, dissolved oxygen, pH, *E. coli* bacteria, total phosphorous and chlorophyll a. The DEQ received 162 sites worth of data comprising of 2151 sampling events. DEQ will use the submitted data to assess water quality conditions at the lake. .

The **Southeast CARE Coalition** is comprised of volunteers living in Newport News. Monitors collect *E. coli* using the Coliscan method along with temperature, salinity, and water clarity. Volunteers sampled at 15 locations 117 times during this assessment cycle. DEQ will use water temperature and *E. coli* data to determine if follow-up sampling is necessary. Salinity and water clarity data were not assessed based on Virginia not having an associated water quality standard.

The **Southern Appalachian Mountain Stewards** collected 305 samples at 227 locations in southwestern Virginia. The project monitored for water temperature, conductivity, and at five locations selenium in order to identify potential impacts of nearby coal mining operations. While the data for temperature and selenium meet Level III quality assurance criteria, the data have limited use to assess monitored waters due to only receiving one or two data points at each location.

Southside Soil and Water Conservation District located in Charlotte and Lunenburg Counties collected 762 *E. coli* samples at 21 locations using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

StreamWatch submitted benthic macroinvertebrate data. Volunteers collected 508 samples at 121 stations located around the Rivanna subbasin. Based on a validation study performed between StreamWatch enhanced benthic monitoring program and DEQ benthic metrics, it was determined that StreamWatch data is of equal quality to DEQ benthic monitoring protocol. DEQ will use the submitted benthic data to assess water quality.

Thomas Jefferson Soil and Water Conservation District volunteers collected 395 *E. coli* samples at 26 sites using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow up monitoring is necessary under the Category 3C/3D portion of the assessment report.

The **Upper Tennessee River Roundtable** (UTRR), collected *E. coli* samples using Coliscan at several creeks located around Wise, Virginia. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Three Creeks TMDL IP. Volunteers

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collected 60 samples at four stations. Based on the training and technical assistance provided by DEQ, the agency is incorporating the data into this report to determine if follow-up monitoring is needed.

The **Virginia Aquarium and Marine Science Center** volunteers sampled at seven locations 347 times during this assessment report. Monitors sampled for common field parameters including dissolved oxygen, pH, and temperature. In addition the on-site laboratory provided analysis for *E. coli* and the inorganic forms of nitrogen. The field parameters meet DEQ criteria to directly assess monitored waters. The nutrient and *E. coli* results may also be assessed but only for waters where the Virginia water quality standard specifies the parameter is appropriate for assessment.

The **Virginia Save Our Streams Program** (VA SOS) is a part of the Virginia Division of the Izaak Walton League of America who coordinates with a number of affiliate organizations across Virginia. Trained VA SOS volunteers collecting benthic macroinvertebrate samples using the VA SOS Modified Rocky Bottom Method and submitted data from 297 stations with valid site coordinates composed of 1637 sample events. DEQ will use SOS data to determine if follow-up monitoring is needed.

Table 3.5-1 Citizen Monitoring Data Considered for Assessment Level II and III

Citizen Monitoring Organization	Atlantic Coast		Chesapeake Bay		Chowan		James		New		Potomac/ Shenandoah		Rappahannock		Roanoke		Tennessee		Yadkin		York		Unknown VPDES		Total	
	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event
Alliance for the Chesapeake Bay			6	251			27	439			19	256	16	1069							6	59	7	49	81	2123
Blackwater Riverkeeper					12	220																		12	220	
Chesapeake Beach Civic League																						14	286	14	286	
Chesterfield WaterTrends							57	1802																57	1802	
Chickahominy Swamp Rats							22	145																22	145	
Clean Virginia Waterways							21	788																21	788	
Coast Guard Auxiliary Flotilla 33			7	14																				7	14	
Cowpasture River Association							20	505																20	505	
Cubitt Creek Monitors											10	70												10	70	
Dividing Creek Association			50	1261																				50	1261	
Fairview Beach Residents Association											69	171												69	171	
Four Creeks Monitors			16	258																				16	258	
Fredericksburg Area Monitors for the Environment													8	30										8	30	
Friends of Norfolk Environment							11	132																11	132	
Friends of the NF Shenandoah River											6	82										2	16	8	98	
Friends of the Russell Fork																19	324							19	324	
Friends of the Shenandoah River											145	10915											79	1135	224	12050
George Mason High School											4	112												4	112	
Goose Creek Association											34	221												34	221	
Historic Green Springs Inc.																				7	44			7	44	
Hoffler Creek Wildlife Refuge							1	72																1	72	
Isle of Wight Ruritan Club					5	59	8	110																13	169	
James River Association							10	141																10	141	
John Marshall SWCD													35	1762										35	1762	
Lake Anna Civic Association																				45	743	5	120	50	863	

Lake Gaston Association									2	8					2	8	
Lake Monticello Owners Association														15	68	15	68
Leesville Lake Association									11	366					11	366	
Lewis Ginter Botanical Gardens				4	79									5	80	9	159
Loudoun Watershed Watch							13	93							13	93	
McClure Restoration Project											24	640			24	640	
Nansemond River Preservation Alliance				9	244										9	244	
New River Conservancy						35	416								35	416	
Northern Neck SWCD								4	4						4	4	
Pebble Creek Property Owners Association				4	26										4	26	
Peninsula Chapter Virginia Master Naturalists				4	51										4	51	
Phi Theta Kappa							2	24							2	24	
Poquoson Citizens for the Environment		26	346												26	346	
Prince William SWCD							17	251							17	251	
Randolph Macon College													10	41	10	41	
RappFLOW								12	24						12	24	
Rippon Middle School							6	21							6	21	
Riverine Chapter VMN				6	104										6	104	
Roanoke Valley Trout Unlimited										10	30				10	30	
Smith Mountain Lake Association										162	2151				162	2151	
Southeast CARE Coalition		1	8		14	109									15	117	
Southern Appalachian Mountain Stewards											226	291		1	14	227	305
Southside SWCD										21	762				21	762	
StreamWatch				120	507			1	1						121	508	
Thomas Jefferson SWCD				26	395										26	395	
Upper Tennessee Roundtable											4	60			4	60	
VA Aquarium	7	347													7	347	
VA Save Our Streams				37	141	4	10	159	888	17	80	77	504	3	14	297	1637

Grand Total Stations / Samples	7 347	106 2138	17 279	401 5790	39 426	484 13104	93 2970	283 3821	276 1329	0 0	68 887	128 1768	1902 32859
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Other Non-Agency Water Quality Monitoring:

By broadening the scope of our data solicitation beyond citizen monitoring, DEQ is receiving water quality data from an expanding pool of government, private industry, and other non-citizen volunteer based monitoring organizations. The guidelines for accepting these datasets are the same as with citizen monitoring data. Each organization must show documented sample collection and testing protocols and pass routine inspections and laboratory audits by the agency. Depending on the degree of compliance with the vetting of the sampling methods and test procedures, the data can either be used directly for assessment or provide locations to establish future DEQ sampling sites.

Prior to the 2004 assessment report, DEQ received water quality monitoring data from the United States Geological Survey (USGS). The data collected by the USGS follows strict adherence to EPA sampling methods and analytical procedures that are fully approved by DEQ. In addition, the United States Forest Service (USFS) routinely submits benthic macroinvertebrate data. The benthic data collected by the USFS follow standard benthic macroinvertebrate monitoring protocols that are similar to DEQ benthic monitoring methods.

Since the 2004 report, additional agencies have begun submitting water quality data for assessment. Most of the data submitted for the 2014 assessment report comes from various federal, state, and local government agencies and select academic institutions.

For the 2016 assessment report, DEQ received data from 19 non-agency organizations which monitored at 1055 sample sites. Zero sites met Level I requirements, 31 met Level II and 1024 met Level III for at least one water quality parameter. Of these 1055 Level II and III stations, 4 sites had either missing sample site coordinates or were located near non representative locations such as at permitted wastewater outfalls. This is a new record in the number of non-agency sample sites included in a Virginia 305(b)/303(d) integrated report.

The following private and government organizations submitted water quality data to DEQ:

Appalachian Electric Power	Maryland Department of the Environment	Pocahontas State Park
Appalachian Technical Services	National Park Service: Assateague Island National Seashore	Tennessee Department of Environment and Conservation
City of Norfolk Department of Utilities	National Park Service: Mid-Atlantic Monitoring Network	Tennessee Valley Authority
City of Suffolk	National Park Service: Northeast Coastal & Barrier Network	United States Forestry Service
Cumberland Resources Corporation	North Carolina Department of Natural Resources	United States Geological Survey
Department of Conservation and Recreation Beach Program	Occoquan Watershed Monitoring Laboratory	Virginia Department of Health Beach Program
James City County Stormwater Division	Page County	Virginia Trout Stream Sensitivity Survey

Below is an alphabetical summary of the water quality data from non-agency organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

Appalachian Electric Power monitored ten stations in the Smith Mountain Lake as part of a study on levels of dissolved copper present in the water column resulting from algae control measures. AEP staff collected 20 samples at 10 locations from January 2009 to September 2009. DEQ will use this data to determine if copper levels are within acceptable aquatic life use criteria.

Appalachian Technical Services (ATS) is a private consultant firm hired to conduct benthic macroinvertebrate sampling in streams that receive discharges from coal mining operations. In 2011 ATS staff sampled at 155 stations in the Big Sandy and Tennessee Rivers collecting benthic macroinvertebrate samples on 266 occasions. Upon review of sample collection and identification protocols, DEQ will use the submitted data to assess aquatic life use at the sampled locations.

The **City of Norfolk Department of Utilities** monitored 18 stations in public drinking water reservoirs for temperature, pH, dissolved oxygen, conductivity and nutrients. DEQ received 841 sample events worth of water quality data and will assess for temperature, pH, dissolved oxygen, and nutrients.

The **City of Suffolk** monitored 18 stations along the lower Nansemond River for temperature, pH, *E. coli*, *Enterococcus*, TSS, salinity, and nutrients. DEQ received 672 samples worth of data and will assess water quality conditions for temperature, pH, bacteria, and nutrients.

The **Cumberland Resources Corporation** collected 44 samples at 2 locations in the Big Sandy River as part of a study of impacts of coal mine discharges to local streams. These samples were to test levels of chloride and will be assessed to determine impacts to aquatic life use.

The **Department of Conservation and Recreation (DCR)** performs monthly fecal bacteria sampling at beaches located in state parks. During this assessment cycle, DCR staff collected 378 *E. coli* samples at 15 locations in the York, James, Roanoke, New and Tennessee Rivers. DEQ will assess the data to determine if bacteria levels impact recreational water quality standards.

The **James City County Stormwater Division** collected *E. coli* samples using the Coliscan Easygel method. From April 2009 to March 2010, county staff collected 140 samples at 12 locations to identify areas of high *E. coli* populations. The results were submitted to DEQ to help with TMDL IP underway in the area to identify locations that could benefit from the installation of BMP's. DEQ included submitted data in this report to determine if follow-up monitoring is necessary.

The **Maryland Department of the Environment** collected and tested 29 *Enterococcus* samples at one location in partnership with the National Park Service Assateague Island National Seashore. DEQ will use the data to assess recreational use conditions at the site.

The **North Carolina Department of Natural Resources** conducted monitoring at two locations at 35 occasions to monitor dissolved oxygen, pH, temperature, conductivity, fecal coliform bacteria, chlorophyll a, and nutrients. DEQ will assess temperature, dissolved oxygen, and pH. Fecal coliform, conductivity, chlorophyll a, and nutrients will not be assessed due to Virginia not having quality standards for these parameters in freshwater riverine systems.

The **National Park Service Assateague Island National Seashore** participates in a multistate monitoring program in waters surrounding Assateague Island on Virginia's Eastern Shore. Park staff collected 88 samples at 7 sites located in Virginia to test for nutrient levels, algae concentration, and field parameters. DEQ will use the nutrient and field parameter data to assess water quality conditions.

The **National Park Service Mid-Atlantic Monitoring Network** is a regional program linking the various National Parks in order to conduct environmental sampling using standardized methodologies. In Virginia, the Appomattox Courthouse National Historical Park, Booker T. Washington National Monument, Fredericksburg and Spotsylvania National Military Park, Petersburg National Battlefield Park, and Richmond National Battlefield Park have participated in this program. From June 2009 to December 2014, the parks monitored 60 stations composed of 2138 sample events. The parks sampled for dissolved oxygen, pH, temperature, and conductivity. After reviewing the protocols, DEQ will assess water quality conditions for dissolved oxygen, pH, and temperature.

The **National Park Service Northeast Coastal & Barrier Network** monitored the Potomac, James and York Rivers for temperature, dissolved oxygen, conductivity, salinity, chlorophyll a, and water clarity. DEQ received 164 samples at 84 sites. After reviewing methodologies, DEQ will assess water quality using temperature and dissolved oxygen. Chlorophyll a and water clarity readings are not used in assessment due to the lack of numerical water quality standards in the sampled waterbodies.

The **Occoquan Watershed Monitoring Laboratory** monitors field parameters and total phosphorous at 15 sites along the Occoquan Reservoir. Trained field and laboratory staff conducted 1,640 sample events during the six year assessment window. Based on review of field and laboratory protocols, DEQ will include the results to assess water quality at the reservoir.

The **Page County Department of Environmental Services** conducted an intensive *E. coli* monitoring program in the Hawksbill Run watershed using Coliscan Easygel. This project was supported through DEQ to determine potential bacteria sources and areas to establish restoration projects as part of the Hawksbill Run TMDL IP. Page County staff sampled at 19 stations in Hawksbill Run collecting 181 samples from January 2009 through February 2010. DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The **Pocahontas State Park** staff monitored a site at Bear Creek and Twin Lakes State Parks for dissolved oxygen, temperature, pH, total phosphorous, and water clarity. DEQ assessed the submitted 83 samples worth of data to

determine if follow up sampling by DEQ is needed.

The **Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources** collected two samples at one location in southeastern Virginia. The TDEC staff collected temperature, pH, dissolved oxygen, and *E. coli*. The data will be included in assessment.

The **Tennessee Valley Authority (TVA)** conducted one site worth of monitoring in Virginia. The monitoring consisted of collecting 14 samples for *E. coli*, temperature, dissolved oxygen, pH, and nutrients at three sites. DEQ will use the nutrient and *E. coli* results to assess water quality. Dissolved Oxygen, pH, and temperature will be used to determine the need for follow up sampling by DEQ due to questions on the frequency and procedures used to calibrate TVA field equipment.

The **United States Forest Service (USFS)** conducts an intensive benthic macroinvertebrate study in and around the national forests in Virginia. The USFS monitored at 82 stations and collected 168 benthic macroinvertebrate samples from March 2009 to April 2014. Upon review of sampling protocols, DEQ will use the benthic macroinvertebrate data for assessing water quality.

The **United States Geological Survey (USGS)** submitted water quality data for 30 stations located in the eastern and central portions of Virginia. USGS staff collected and submitted data from 794 sample events from January 2009 to December 2014. The stations monitored many ambient water quality parameters from dissolved oxygen and pH to dissolved metals. In addition, USGS conducted continuous monitoring of dissolved oxygen, pH, and temperature at 11 stations composed of 750,685 readings during the six year window. The USGS follows standard protocols for sampling and analysis of results. USGS monitoring data identified as having a Virginia Water Quality Standard were used by DEQ to assess water quality.

The **Virginia Department of Health (VDH)** collects *E. coli* and fecal Enterococcus bacteria samples from public beaches located in the eastern half of Virginia from May to October each year. For this assessment report, VDH staff collected 5,312 bacteria samples from 47 public beaches and submitted the results to DEQ. Due to VDH using the same sampling methods and laboratory procedures used by DEQ, VDH results were used by DEQ to assess water quality.

The **Virginia Trout Stream Sensitivity Survey** is managed the University of Virginia Department of Environmental Sciences and conducts a majority of water quality testing of waterbodies that support native brook trout and with an emphasis of testing on public lands such as national parks and forests. The program collected 469 sites worth of data over 2766 sampling events. Monitoring included water temperature, pH, conductivity, hardness and ions such as chloride. This data will be used by DEQ to determine follow up sampling is needed.

The **Wolf Creek Water Reclamation Facility** submitted water quality data collected upstream of their facility to DEQ. From January 2009 through December 2014 the staff collected 52 samples from one sample site located upstream of their facility. Submitted data included stream flow, temperature, dissolved oxygen, pH, Biochemical Oxygen Demand, nutrients, and *E. coli* bacteria. DEQ will assess water quality for temperature, pH, nutrients, and *E. coli*.

Table 3.5-2 Non-Agency Data Submitted: Level II and Level III

Non-Citizen Monitoring Organization	Atlantic Ocean		Chesapeake Bay		Chowan		James		New		Potomac / Shenandoah		Rappahannock		Roanoke		Tennessee		Yadkin		York		Unknown VPDES		Total	
	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event	Site	Event
Appalachian Electric Power																									10	20
Appalachian Technical Services																	155	266							155	266
City of Norfolk Department of Utilities							16	745													2	96			18	841
City of Suffolk							18	672																	18	672
Cumberland Resources Corporation																	2	44							2	44
Department of Conservation and Recreation							6	176	1	26					2	45	5	106			1	25			15	378
James City County Stormwater Division							12	140																	12	140
Maryland Department of the Environment	1	29																							1	29
North Carolina Department of Natural Resources					1	20									1	15									2	35
National Park Service: Assateague Island National Seashore	7	88																							7	88
National Park Service: Mid-Atlantic Monitoring Network					5	105	15	601			15	400	5	259	5	253	2	20			13	500			60	2138
National Park Service: Northeast Coastal & Barrier Network							33	52			46	104									5	8			84	164
Occoquan Watershed Monitoring Laboratory											15	1640													15	1640
Page County											19	181													19	181
Pocahontas State Park							6	83																	6	83
Tennessee Department of Environment and Conservation																	1	2							1	2
Tennessee Valley Authority																	1	14							1	14
United States Forestry Service							44	95	8	15	17	40					9	13					4	5	82	168
United States Geological Survey											27	767					1	27							30	794
Virginia Department of Health Beach Program	16	1727	19	2227			9	1035			1	117									2	206			47	5312
Virginia Trout Stream Sensitivity Survey							178	559	76	238	103	1050	36	726	23	23	51	168	2	2					469	2766

Wolf Creek Water Reclamation Facility															1	52							1	52		
Grand Total Stations / Samples	24	1844	19	2227	6	125	337	4158	85	279	245	4299	41	985	41	356	228	712	2	2	23	835	4	5	1055	15827

Current Efforts to Support Citizen and Non-Agency Surface Water Quality Monitoring

DEQ is committed to expanding the use of non-agency surface water quality monitoring data in future assessment reports. This is primarily due to an increasing need for additional water quality data and the growth in the sophistication in water quality monitoring by sources outside of DEQ. During the past couple of years, DEQ continues to develop new content and resources to increase the amount and quality of non-agency data available.

In response to citizen concerns raised about algae growth impacting recreation use in the Shenandoah River, DEQ has committed to developing a quantifiable, repeatable field estimation method for evaluating potential impacts of algal growth in Virginia's free flowing waters. Virginia is currently testing field methods and will develop a plan for the use of citizen monitoring data in assisting with recreational use attainment determinations.

Due to the popularity of the Coliscan Easygel method by volunteer groups, the agency developed a comprehensive guide to correctly identify *E. coli* colonies using this method. The guide is available to monitoring groups by going to

www.deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/Guidance.aspx.

In 2005, DEQ, in partnership with the Virginia Water Monitoring Council (VWMC), developed a web-enabled application for the public to find contact information on water quality monitoring organizations across Virginia. In 2013, this application was moved to a Google based platform and now shows the locations of monitoring sites found on the DEQ citizen/non-agency database at www.deq.virginia.gov/easi/. By using Google maps, it allows for faster updates and more capabilities than possible using the standard GIS mapping software. The VWMC application is accessible through the VWMC website <http://vwrrc.vt.edu/vwmc/data.asp> or by visiting the DEQ follow up monitoring website www.deq.virginia.gov/programs/water/waterqualityinformationtmdls/waterqualitymonitoring/citizenmonitoring/followupmonitoring.aspx.

Currently, DEQ is developing a series of training videos covering popular water quality monitoring methods such as Coliscan Easygel and dissolved oxygen sampling. The goal of these videos is to provide introductory or refresher training that volunteer groups can refer to. In addition, these videos will supplement material found in the popular *Virginia Citizen Volunteer Water Quality Monitoring Program Methods Manual* available on the DEQ citizen monitoring page at www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx

Through these new and continuing efforts, DEQ is able to utilize data that was previously unavailable or unknown to the agency. DEQ values the contributions of non-agency monitoring staff and citizen volunteers and will continue to support their monitoring efforts however possible. With assistance from these organizations, DEQ is increasing monitoring coverage in Virginia.

Additional information about DEQ's continued support of volunteer and non-agency monitoring is available at:

www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx

You May Also Contact:

James Beckley
Quality Assurance Coordinator
PO Box 1105
Richmond, Virginia 23219
(804) 698-4025
james.beckley@deq.virginia.gov

Stuart Torbeck
Water Quality Data Liaison
PO Box 1105
Richmond, Virginia 23219
(804) 698-4461
stuart.torbeck@deq.virginia.gov